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OZONE MEASUREMENTS TO 48KM WITH CHEMILUMINESCENT OZONE DETECTOR--ETC(U)

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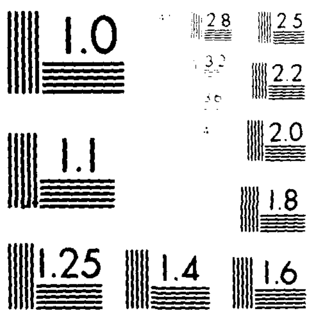

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OZONE MEASUREMENTS TO 48km WITH CHEMILUMINESCENT OZONE DETECTORS *

Annual Progress Report

Submitted by

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Ozone Measurements To 48km With Chemiluminescent Ozone Detectors

Introduction

This report covers the second year (1981 calendar year) of research in our effort to build and fly a reliable and stable ozone detector capable of functioning to approximately 50km on a lightweight balloon made out of a newly available thin film material. Much of the work centered around testing a new in-flight calibrator for ozone detectors. In addition a more sensitive Rhodamine-B (Rhd-B) chemiluminescent ozone detector utilizing a photon counting system was constructed, tested and flown.

The In-Flight Ozone Calibrator

The operating principle of this device is extremely simple. A fixed flow of constant temperature, clean, dry air is passed through a quartz tube which is irradiated by a constant intensity UV light source. The ozone generated by the UV has a concentration proportional to the oxygen concentration in the original air flow. Figure 1 shows the output of the ozone calibrator as a function of pressure and confirms the linear relationship between the oxygen concentration and ozone output. The present major disadvantage of this device is the rather low output at high altitude.

The data shown in figure 1 were obtained with an electro-chemical cell (ECC) identical to those that have seen widespread application in balloon borne measurements of ozone. Since the ECC contains water, it can only be trusted to about 25km (25mb) altitude. It was found in one of our tests that by decreasing the temperature of the ECC by 20°C,

its response appeared to decrease quite noticeably. At the present time it is not known if this reflects on the ECC cell or the ozone calibrator. However, the same effect was observed during a balloon flight in which the ECC was allowed to cool somewhat. This problem must be resolved before we can employ the ozone calibrator with confidence.

A test flight was conducted (Nov. 30, 1981) in which 3 ozone detectors were used: the original Rhd-B detector, the more sensitive Rhd-B detector and the ECC detector. In addition the ozone calibrator was used to calibrate all three instruments periodically throughout the entire balloon flight. Figure (2) shows the results using the ground level calibration. Figure (3) shows the results using the in-flight calibration and assumes the output of the calibrator is correctly represented by figure (1). A comparison of figures (2) and (3) readily shows the need for in-flight calibrations for those detectors.

One would expect the in-flight calibrations to make the ozone profiles obtained from all three instruments appear quite similar. As can be seen in figure 3 this is definitely not the case. The observed disagreement indicates that there are major problems yet to be solved concerning the linearity of the detectors and/or the internal plumbing of the three detector flight package.

Future Research Plan

A serious effort will be needed to resolve the discrepancy in the ECC and the ozone calibrator. To do this, it will be necessary to employ an ozone detector based on the UV absorption principle. This Device, although slow in response, is highly reliable compared to the detectors we are now using. This is going to cause a significant delay

in our goal of making reliable ozone measurements to 50km by balloons. However, we hope to utilize the advances made by other research groups in the use of the UV absorption technique as applied to balloon soundings.

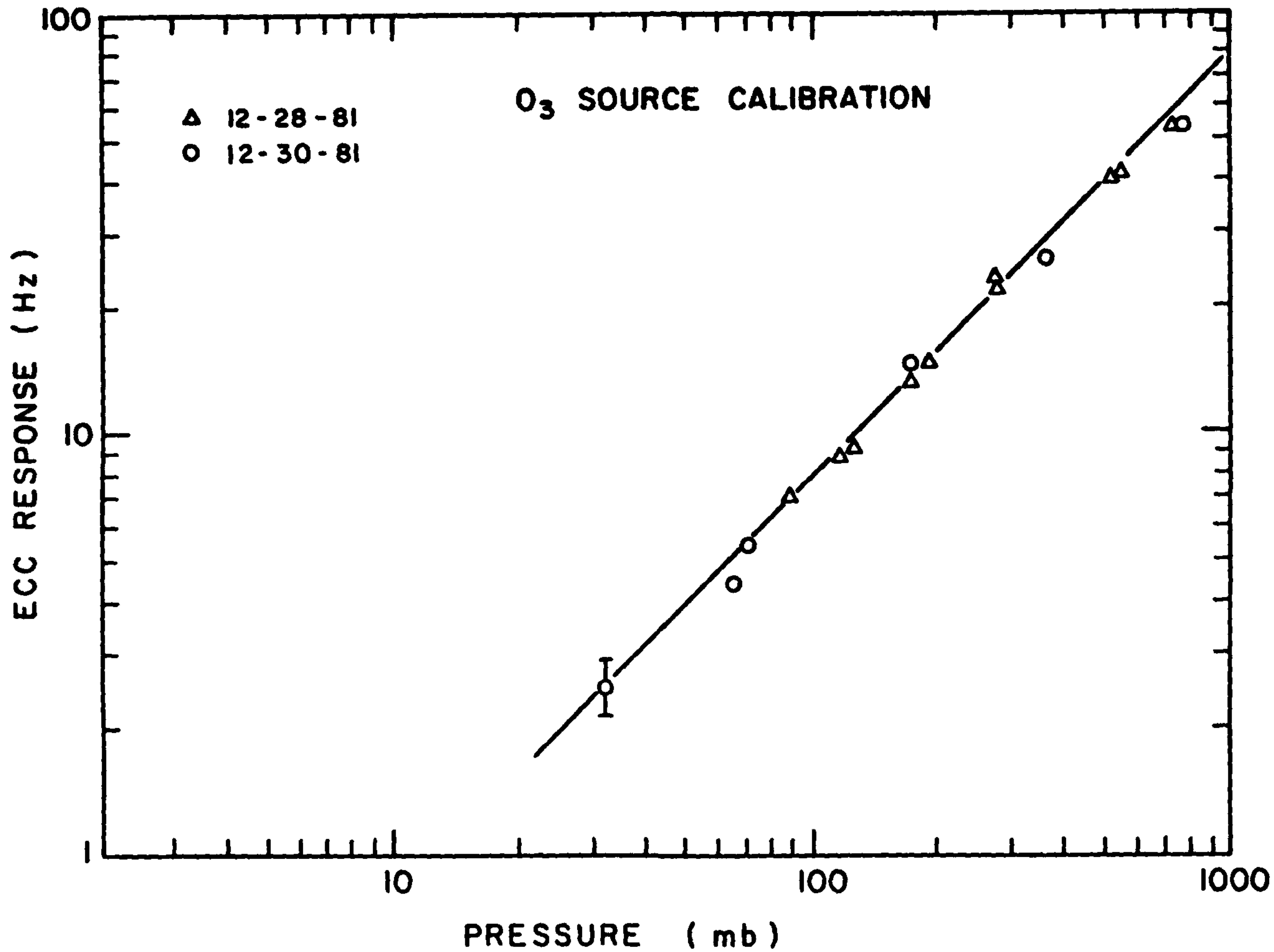

Figure 1. A bell jar test of the in-flight ozone calibrator. The solid straight line is for a calibrator output directly proportional to the ambient pressure.

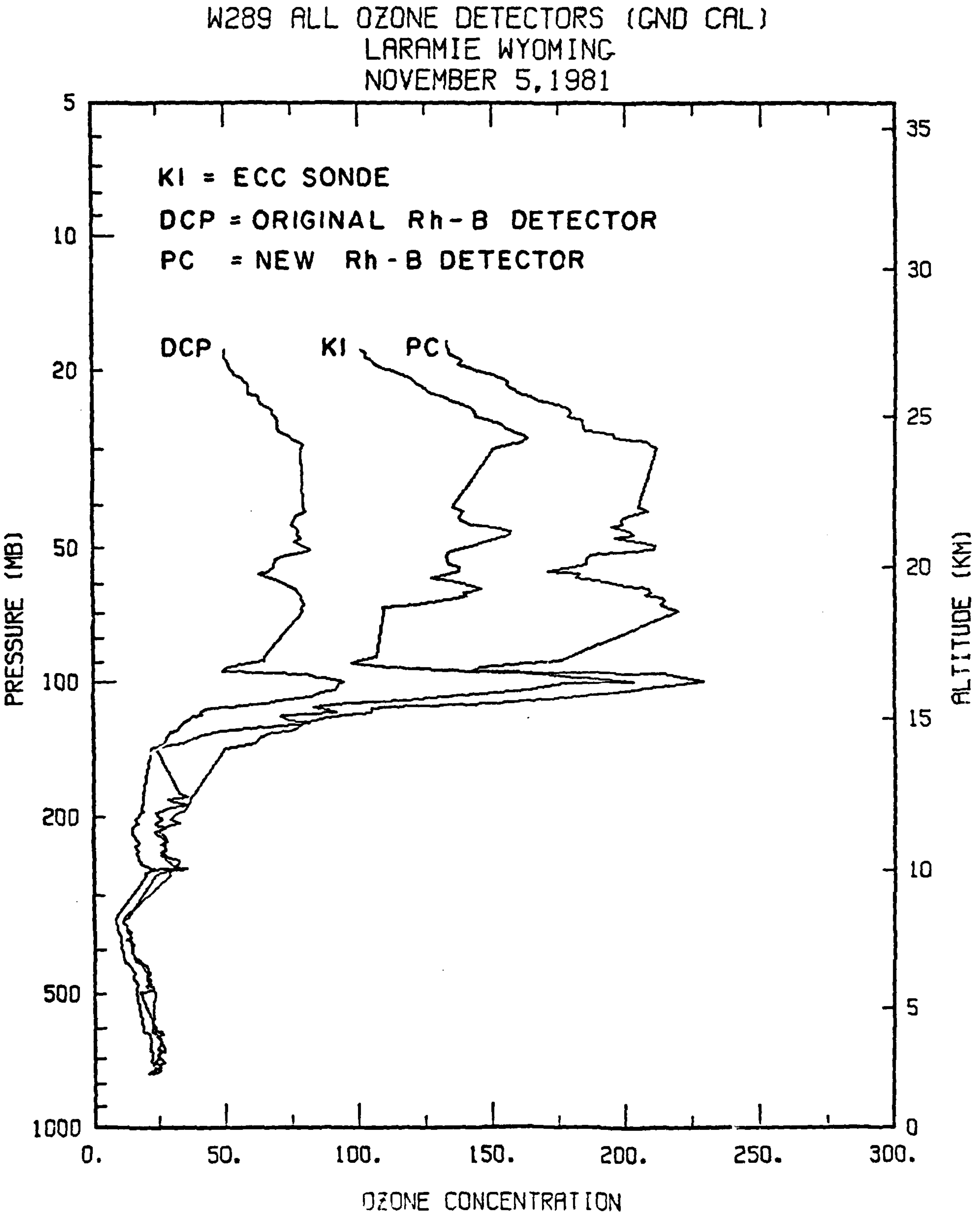

Figure 2. A comparison of the three ozone detectors flown simultaneously on Nov. 30, 1981 over Laramie. The ground level instrument calibration was used in preparing this figure.

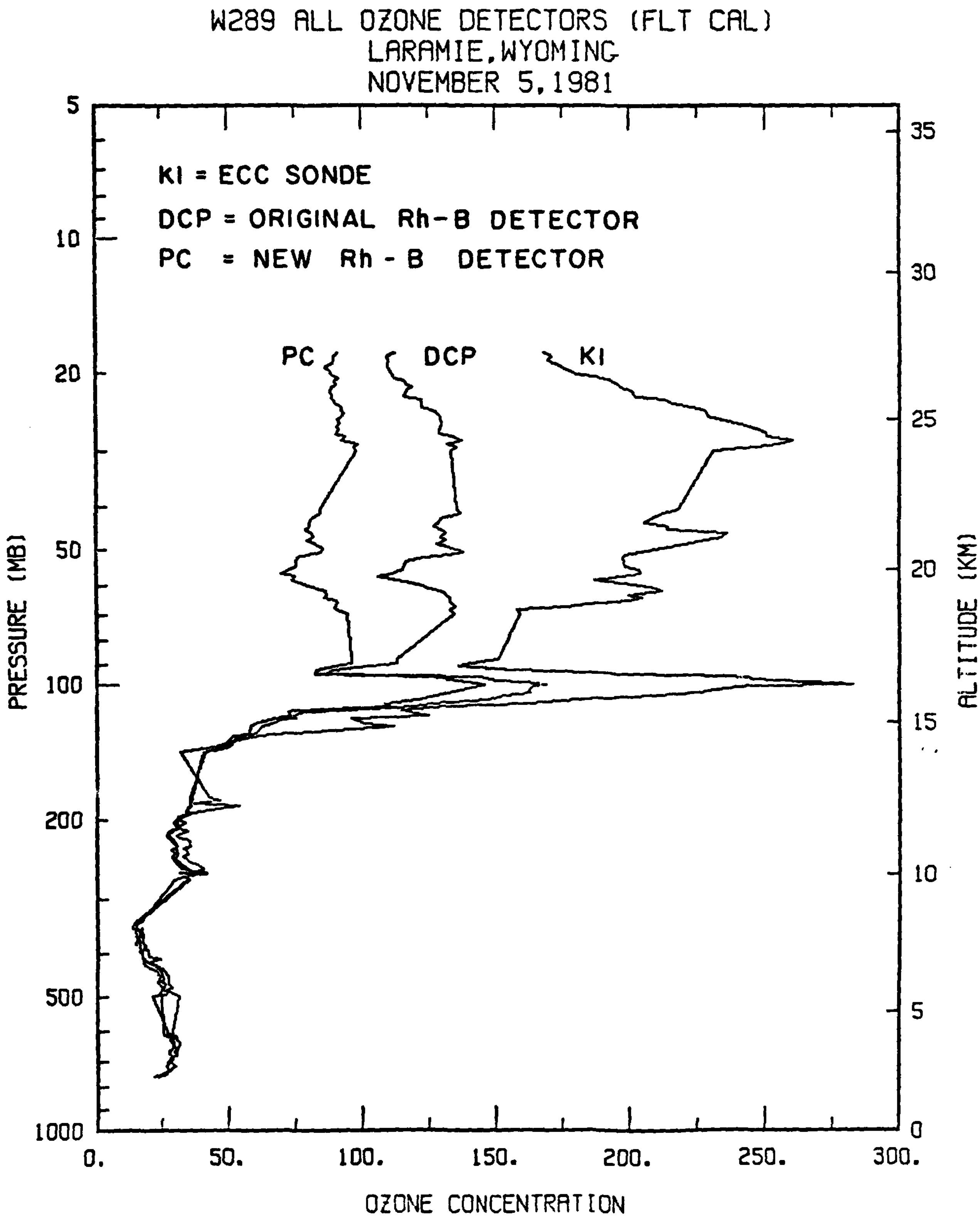

Figure 3. A comparison of the three ozone detectors flown simultaneously on Nov. 30, 1981 over Laramie. The in-flight calibration was used in preparing this figure.

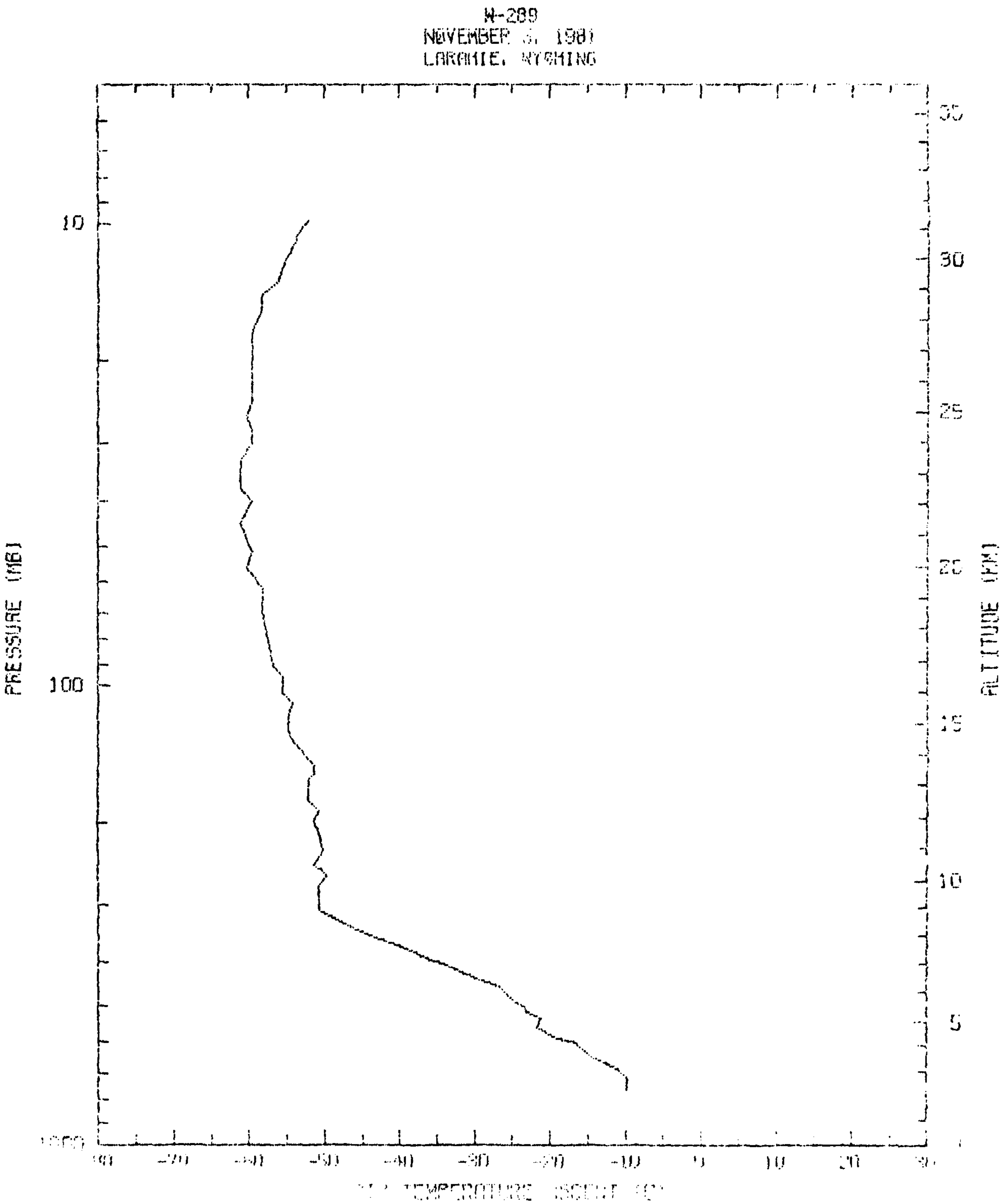

Figure 4. The ambient temperature profile corresponding to figures 2 and 3.

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ht ozone calibrator was tested both in a laboratory environmental
nd on a balloon flight. The results demonstrate the need for an in-
librator and also indicate that there may be a serious and previously
d temperature sensitivity problem with one of the primary ozone detect-

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